

# Creatinine levels among Mexican Americans, Puerto Ricans, and Cuban Americans in the Hispanic Health and Nutrition Examination Survey

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## **Creatinine levels among Mexican Americans, Puerto Ricans, and Cuban Americans in the Hispanic Health and Nutrition Examination Survey.**

**Background.** Although Latinos constitute the largest and fastest growing minority group in the United States, little is known about the prevalence of renal disease among different Latino subgroups.

**Methods.** We used data from the Hispanic Health and Nutrition Examination Survey (HHANES) to compare serum creatinine measurements among Mexican Americans, mainland Puerto Ricans, and Cuban Americans. We compared estimated creatinine clearance across Latino subgroups adjusted for demographic, clinical, and socioeconomic characteristics (including known predictors of chronic kidney disease) using survey logistic regression analysis.

**Results.** Cuban Americans had higher mean serum creatinine levels than the other groups across both gender and age categories. In multivariable analysis, Puerto Ricans [odds ratio (OR) 1.74, 95% confidence interval (CI) 1.16 to 2.60] and Cuban Americans (OR 4.59, CI 2.53 to 8.31) were more likely than the referent category of Mexican Americans to have an estimated creatinine clearance  $<60$  mL/min/1.73m<sup>2</sup>.

**Conclusion.** Serum creatinine levels differ substantially among Latino subgroups, suggesting national origin needs to be taken into consideration in studies of renal disease in Latinos. In addition, our findings highlight the need for more contemporary studies directly comparing both incidence rates of end-stage renal disease and measured renal function among Latino subgroups, perhaps leading to subgroup-specific prediction equations.

**Key words:** Latino, Hispanic, Puerto Rican, Mexican American, Cuban American, creatinine, renal.

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Latinos now constitute the largest and fastest growing minority group in the United States (U.S.) [1]. However, information on the incidence and prevalence of renal disease among Latinos is sparse and somewhat conflicting. According to United States Renal Data System (USRDS) data from the late 1990s, Hispanic whites had a higher incidence of end-stage renal disease (ESRD) compared with non-Hispanic whites [2]. However, based on data from the Third National Health and Nutrition Examination Survey (NHANES III), moderately decreased kidney function was actually less prevalent among Mexican Americans than among either non-Hispanic whites or blacks, although Mexican Americans were more likely than non-Hispanic whites to have microalbuminuria [3, 4].

While almost two thirds of Latinos in this country are Mexican Americans, Latinos from other national origins, such as Central and South Americans, Puerto Ricans, and Cuban Americans represent a sizeable minority, lending considerable socioeconomic, ethnic, and racial diversity to the U.S. Latino population. Several studies have demonstrated a high prevalence of known risk factors for kidney disease among Latinos. For example, the prevalence of diabetes appears to be higher among Latinos than among non-Latino whites [5]. Furthermore, there is considerable variability in the prevalence of several kidney disease risk factors across Latino subgroups. For example, Cuban Americans have a lower prevalence of diabetes, while the prevalence of hypertension is similar among Latino subgroups [5, 6]. Smoking is more prevalent among Puerto Ricans and Cuban Americans than among Mexican Americans [7, 8], and Puerto Rican women appear to be at higher risk of having low birth weight infants compared with Cuban and Mexican American women [9]. There is also considerable variation

in health insurance coverage across Latino subgroups [10].

Despite the existence of considerable variability in risk factors for kidney disease among Latinos, no prior studies have compared the prevalence of renal insufficiency across Latino subgroups. In the present analysis, we used data from the Hispanic Health and Nutrition Examination Survey (HHANES) to compare serum creatinine measurements and estimated glomerular filtration rate among Latino subgroups.

## METHODS

### Data source

The HHANES was a stratified probability cluster sample of Latino households in three regions of the U.S. conducted from 1982 to 1984. Participants were selected from households in which the household head was a noninstitutionalized civilian person of Mexican origin or ancestry in the Southwest, of Puerto Rican origin in New York, New Jersey, and Connecticut, or of Cuban origin in Dade County, Florida. The survey included an interview, physical examination, and phlebotomy, and is described in more detail elsewhere [5, 6].

### Outcome variable

The outcome variables for the present analysis were measured serum creatinine and Cockcroft-Gault estimated creatinine clearance [11]. Survey logistic regression analyses were performed to measure the association of Latino subgroup (Mexican American, Puerto Rican, or Cuban American) with an estimated creatinine clearance  $<60$  mL/min/1.73m<sup>2</sup> to denote the presence of at least moderate renal insufficiency according to K/DOQI guidelines [12].

### Predictor variables

The primary predictor variable for the present analysis was Latino subgroup (Puerto Rican or Mexican or Cuban American). Multivariable analysis was adjusted for known predictors of kidney disease, including age and gender, comorbid conditions, and socioeconomic status. Consistent with prior analyses of HHANES data, self-reported race was not included in any analyses because this was felt to be unreliable based on the low observed numbers of Puerto Ricans reporting black race [5]. We used information on language preference and place of birth to indicate degree of acculturation: participants were classified as preferring Spanish if they indicated a preference for Spanish or “mostly” Spanish in response to the question “What language do you prefer: Spanish only, mostly Spanish, mostly English, English only, or Spanish and English about equally.” Participants were classified as first-generation Americans if they were born outside

the mainland U.S. (i.e., in Mexico, Puerto Rico, or Cuba). Education was recorded as the highest grade or years of schooling attended. The poverty index is a ratio of the midpoint of the income bracket reported for each family divided by the poverty threshold specific to the family size, adult-child composition of the family, age of the reference person, and month and year of the interview. Thus, a low index indicates a greater degree of poverty. Participants were classified as having no health insurance versus some health insurance in the form of either private or military coverage or Medicare.

Participants were considered to have diabetes if they reported having a history of diabetes, if they reported ever taking insulin or oral hypoglycemic agents, or if their random glucose was  $\geq 200$  mg/dL or fasting glucose  $\geq 126$  mg/dL (after an 8-hour fast). Participants were considered hypertensive if they had a mean systolic pressure  $\geq 140$  mm Hg, a mean diastolic pressure  $\geq 90$  mm Hg, or if they reported currently taking antihypertensive medications. Participants were considered to have a history of congestive heart failure, myocardial infarction, or stroke if they reported ever being told by a physician that they had experienced one of these events. Participants were considered smokers if they reported currently smoking. Participants were classified as obese if they had a body mass index (BMI)  $\geq 30$  kg/m<sup>2</sup>. We also included total serum cholesterol measurements.

### Study sample

Although the survey required that at least one person within each selected household be of either Mexican origin or ancestry in the Southwest, of Puerto Rican origin in New York, New Jersey, and Connecticut, or of Cuban origin in Dade County, Florida, some members of Latino households sampled in the survey did not meet these criteria. We thus included only sampled persons who met these criteria. The study sample was further restricted to eligible participants with measured serum creatinine levels.

### Statistical analysis

All analyses were conducted with sample examination weights using STATA statistical software for complex survey design (Stata Corporation, College Station, TX, USA). Survey weights express each person's probability of selection for the examination and are adjusted for nonparticipation. Demographic characteristics, comorbid conditions, and socioeconomic status were compared across Latino subgroups using a chi-square test (for categorical variables) or a survey regression model for continuous predictors. We used survey logistic regression analysis to measure the unadjusted and adjusted associations of Latino subgroups with the dichotomous outcome of estimated creatinine clearance  $<60$  mL/min/1.73m<sup>2</sup>.

**Table 1.** Sociodemographic characteristics by Latino subgroup

Characteristic	Mexican American (N = 2999)	Puerto Rican (N = 1025)	Cuban American (N = 820)	P value
Age $\pm$ SE years	37 $\pm$ 0.4	38 $\pm$ 0.5	45 $\pm$ 0.7	<0.001
Women % $\pm$ SE	50 $\pm$ 1.0	62 $\pm$ 2.0	55 $\pm$ 2.0	<0.001
Acculturation				
First generation % $\pm$ SE	36 $\pm$ 2.0	75 $\pm$ 2.0	97 $\pm$ 1.0	<0.001
Prefer Spanish % $\pm$ SE	30 $\pm$ 1.0	33 $\pm$ 2.0	44 $\pm$ 3.0	0.001
No health insurance % $\pm$ SE	38 $\pm$ 2.0	48 $\pm$ 5.0	30 $\pm$ 2.0	0.029
Poverty index $\pm$ SE	2.0 $\pm$ 0.04	1.8 $\pm$ 0.1	2.4 $\pm$ 0.07	0.002
Mean years of schooling attended $\pm$ SE	9.4 $\pm$ 0.2	10.2 $\pm$ 0.2	10.4 $\pm$ 0.2	0.008

SE, standard error. A low poverty index indicates a greater degree of poverty. All values represent estimates for the study population based on weighting of sample data.

**Table 2.** Clinical characteristics by Latino subgroup

	Mexican American (N = 2999)	Puerto Rican (N = 1025)	Cuban American (N = 820)	P value
Diabetes % $\pm$ SE				0.35
No insulin % $\pm$ SE	5.8 $\pm$ 0.4	5.8 $\pm$ 0.6	5.1 $\pm$ 0.8	
Insulin % $\pm$ SE	1.3 $\pm$ 0.2	1.1 $\pm$ 0.3	0.5 $\pm$ 0.2	
Hypertension % $\pm$ SE	16 $\pm$ 0.6	14 $\pm$ 1.0	20 $\pm$ 1.0	0.028
Congestive heart failure % $\pm$ SE	0.9 $\pm$ 0.2	2.9 $\pm$ 0.1	1.3 $\pm$ 0.1	<0.001
Myocardial infarction % $\pm$ SE	1.5 $\pm$ 0.3	2.4 $\pm$ 0.5	2.5 $\pm$ 0.7	0.15
Current smoker % $\pm$ SE	34 $\pm$ 1.0	31 $\pm$ 2.0	36 $\pm$ 2.0	0.39
Percent with a body mass index $\geq$ 30 kg/m <sup>2</sup> $\pm$ SE	19 $\pm$ 1.0	17 $\pm$ 1.0	16 $\pm$ 2.0	0.20
Mean cholesterol $\pm$ SE mg/dL	202 $\pm$ 0.9	202 $\pm$ 3.1	205 $\pm$ 1.3	0.27

SE, standard error. All values represent estimates for the study population based on weighting of sample data.

Years of schooling attended and serum cholesterol were nonlinearly associated with the outcome, and were thus modeled by quartile.

## RESULTS

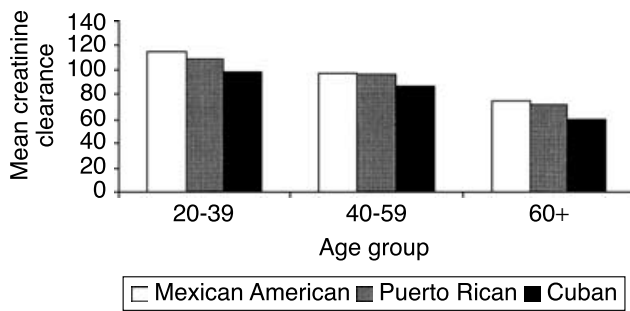
A total of 9060 of the 9643 HHANES participants were either of Mexican origin or ancestry in the Southwest, of Puerto Rican origin in the New York area, or of Cuban origin in Dade County, Florida. Among these, serum creatinine measurements were obtained on 4845 of the 5267 participants between the ages of 20 and 75 who were eligible for creatinine measurement. We elected to exclude from the present analysis one person with an outlier serum creatinine level of 10.5 mg/dL. The study sample thus consisted of the subset of 4844 persons with measured serum creatinine belonging to one of the three Latino subgroups outlined above.

Compared with Mexican Americans and Puerto Ricans, Cuban Americans were older, most likely to be first-generation Americans, most likely to speak Spanish, most likely to have health insurance, had the lowest poverty level (as indicated by the highest mean poverty index), were the most highly educated, and had the highest percent prevalence of hypertension (Tables 1 and 2). Mean serum creatinine was highest for Cuban Americans across all gender and age group categories (Table 3). Mean creatinine clearance was lowest, and percent of persons with an estimated clearance  $<60$  mL/min/1.73m<sup>2</sup> was highest for Cuban Americans (Figs. 1 and 2). This was

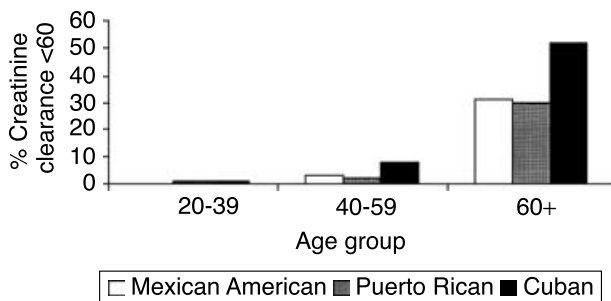
**Table 3.** Mean serum creatinine stratified by age, sex, and Latino subgroup

	Mean serum creatinine, mg/dL $\pm$ standard error (sample size)			P value
	Mexican American (N = 2999)	Puerto Rican (N = 1025)	Cuban American (N = 820)	
Men				
All (N = 2065)	1.01 $\pm$ 0.01 (N = 1320)	1.0 $\pm$ 0.01 (N = 384)	1.12 $\pm$ 0.02 (N = 361)	<0.001
By age group				<0.001
20–39	1.00 $\pm$ 0.01 (N = 736)	1.0 $\pm$ 0.01 (N = 174)	1.08 $\pm$ 0.03 (N = 105)	
40–59	1.01 $\pm$ 0.01 (N = 432)	1.00 $\pm$ 0.01 (N = 167)	1.10 $\pm$ 0.02 (N = 185)	
60+	1.10 $\pm$ 0.06 (N = 152)	1.05 $\pm$ 0.01 (N = 43)	1.25 $\pm$ 0.03 (N = 71)	
Women				
All (N = 2779)	0.82 $\pm$ 0.01 (N = 1679)	0.84 $\pm$ 0.01 (N = 641)	0.93 $\pm$ 0.01 (N = 459)	<0.001
By age group				<0.001
20–39	0.80 $\pm$ 0.01 (N = 922)	0.83 $\pm$ 0.01 (N = 303)	0.90 $\pm$ 0.02 (N = 154)	
40–59	0.82 $\pm$ 0.01 (N = 573)	0.84 $\pm$ 0.01 (N = 260)	0.92 $\pm$ 0.01 (N = 211)	
60+	0.92 $\pm$ 0.04 (N = 184)	0.94 $\pm$ 0.02 (N = 78)	1.04 $\pm$ 0.04 (N = 94)	

most pronounced for those 60 years and older. In unadjusted analysis, compared with Mexican Americans, the odds of having an estimated creatinine clearance  $<60$  mL/min/1.73m<sup>2</sup> were not significantly different for Puerto Ricans but were 4-fold higher for Cuban Americans



**Fig. 1.** Mean estimated creatinine clearance in mL/min/1.73m<sup>2</sup> by Latino subgroup.



**Fig. 2.** Percent with creatinine clearance <60 mL/min/1.73m<sup>2</sup> by Latino subgroup.

**Table 4.** Univariate and multivariate association of Latino subgroup with creatinine clearance <60 mL/min/1.73m<sup>2</sup>

	Unadjusted	Adjusted for age and sex	Additionally adjusted for comorbid conditions and socioeconomic characteristics <sup>a</sup>
Mexican American	1.00 (referent)	1.00 (referent)	1.00 (referent)
Puerto Rican	0.98 (0.67, 1.43)	1.21 (0.94, 1.57)	1.74 (1.16, 2.60)
Cuban American	4.01 (2.54, 6.34)	3.01 (2.15, 4.20)	4.59 (2.53, 8.31)

<sup>a</sup>Adjusted for age, sex, acculturation, health insurance status, poverty index and education, diabetes, hypertension, history of heart failure, history of myocardial infarction, history of stroke, current smoking, obesity, and serum cholesterol.

(Table 4). After further adjustment for socioeconomic status and comorbid conditions, both Cuban Americans and Puerto Ricans were more likely than Mexican Americans to have a low estimated creatinine clearance. This was most pronounced for Cuban Americans.

## DISCUSSION

The present analysis demonstrates striking differences in creatinine levels and related estimates of creatinine clearance among Mexican Americans, Puerto Ricans, and Cuban Americans participating in HHANES. Compared with the other groups, Cuban Americans had the highest creatinine levels, the lowest estimated creatinine clear-

ances, and the highest percentage of patients with an estimated creatinine clearance <60 mL/min/1.73m<sup>2</sup>. These differences persisted after adjustment for age, sex, comorbid conditions, and socioeconomic status. While Puerto Ricans and Mexican Americans had similar mean creatinine levels and estimated creatinine clearances, after adjustment for comorbid conditions and socioeconomic status, Puerto Ricans were more likely than Mexican Americans to have an estimated creatinine clearance <60 mL/min/1.73m<sup>2</sup>. These findings caution against epidemiologic studies of renal disease that include Mexican Americans, Puerto Ricans, and Cuban Americans in a single Latino or Hispanic category, or that generalize from Mexican Americans to other Latino subgroups.

The observed differences in serum creatinine levels among Latino subgroups may represent true differences in renal function or may represent differences in creatinine production and excretion. The results presented here cannot be easily compared with prior published reports of serum creatinine among Latino subgroups both because data on renal function among Puerto Ricans and Cuban Americans are sparse, and because serum creatinine measurements obtained in different laboratories and/or during different time periods are often not comparable [13, 14]. For example, serum creatinine values from HHANES can only be compared to those for subsequent NHANES surveys for Mexican Americans because other Latino groups were not represented in these surveys. While serum creatinine values among Mexican American men and women in NHANES III were higher than in the present study, these measurements were performed at different laboratories at different times, and the surveys were conducted over a decade apart, during which time the epidemiology of kidney disease among Mexican Americans may have changed. A recent study conducted in Cuba examined the urinary excretion of creatinine in the adult Cuban population [15]. Mean serum creatinine levels reported for the Cuban study were quite similar to the values reported here (for men 1.13 mg/dL vs. 1.12 mg/dL in the present study, and for women 0.93 in both studies); however, mean body mass index differed dramatically from HHANES, and again, these measurements are not calibrated to those obtained in HHANES.

The Cockcroft-Gault and Modification of Diet in Renal Disease (MDRD) equations [16, 17] both use serum creatinine levels to estimate renal function, and are thus critically dependent on the calibration and reproducibility of the serum creatinine assay. Both formulas were derived from study populations that did not include Latinos, and neither has been validated in Latinos or in racial groups other than African Americans and whites [16, 17]. African Americans are known to have higher serum creatinine levels than whites with comparable glomerular filtration rates [18]. This observation is probably explained by a higher muscle mass in African Americans

[19–21]. While differences in genetic admixture among groups with different national origins is one possible explanation for differences in serum creatinine levels, our results suggest that this is at best an incomplete explanation for observed differences in serum creatinine levels across these groups. While Puerto Ricans have the highest rates of African admixture compared with other groups, their creatinine levels were similar to those of Mexican Americans, and fell below those of Cuban Americans [22]. On the other hand, it is certainly possible that Cuban Americans may have higher serum creatinine values than Mexican Americans and Puerto Ricans due to greater muscle mass, but this possibility cannot be addressed using HHANES data because neither urine creatinine measurements nor more direct measures of glomerular filtration rate are available for Latino subgroups. Further studies are needed to understand the clinical significance of these findings. Specifically, correlation of serum creatinine levels with measured renal function by Latino subgroup would help to determine whether there are true intergroup differences in renal function, or whether differences in serum creatinine levels reflect differences in creatinine production and excretion, calling for the development of subgroup-specific glomerular filtration rate or creatinine clearance prediction equations.

Data on the incidence of ESRD among Latino subgroups could also help to determine the clinical significance of observed variations in serum creatinine levels, although incidence of ESRD reflects not just differences in the prevalence, but also in the rate of progression of renal disease. Data from the 1980s also indicated that there was an excess incidence of treatment of ESRD in Mexican Americans living in Texas [23]. Furthermore, the excess incidence of ESRD persisted even after adjustment for the excess prevalence of diabetes among Mexican Americans as compared to whites [23, 24]. More recent USRDS data indicate that ESRD incidence rates are higher for Hispanics than for white non-Hispanics [25]. These rates probably reflect primarily rates for Mexican Americans, who represent the largest Latino subgroup in the U.S. Unfortunately, while data from USRDS based on the Medical Evidence Form indicates Hispanic ethnic group and Mexican American ethnicity, further breakdown by Latino subgroup is not currently available. Smaller scale studies in geographic areas where particular Latino subgroups predominate might represent one approach to exploring differences in ESRD incidence rates by Latino subgroup.

The present study has several limitations. First, HHANES was performed 20 years ago, and it is unclear whether the differences in serum creatinine measurements across Latino subgroups observed in HHANES continue to exist today. However, to date, HHANES is the only representative survey of Latinos for which serum creatinine measurements are available. Thus, fur-

ther studies are needed to confirm the applicability of these findings to contemporary Latino Americans. Second, while the present study draws attention to the existence of dramatic differences in serum creatinine measurements across Latino subgroups, we had limited ability to investigate the significance of these differences. In multivariable analysis, we were able to establish that these differences did not reflect differences among groups in age and sex composition, comorbid conditions, or socioeconomic status, all of which may be associated with serum creatinine level. However, some putative risk factors for kidney disease that may account for differences in serum creatinine levels across Latino subgroups (e.g., birth weight) were not available in the dataset. Furthermore, the race variable in HHANES was felt to be unreliable, and was thus not included in our analyses. However, differences in racial composition are unlikely to account for high serum creatinine levels among Cuban Americans seen in the present analysis. Unfortunately, the lack of measured creatinine clearance or urinary creatinine production in HHANES precluded further analysis to determine whether observed differences in serum creatinine levels reflected real differences in renal function versus differences in creatinine production and/or excretion. In addition, ESRD incidence data by Latino subgroup are not currently available through USRDS, limiting our ability to make inferences about the clinical significance of observed differences in serum creatinine levels across groups. Finally, because Mexican Americans, Puerto Ricans, and Cubans enrolled in HHANES were living in different geographic areas within the U.S., we cannot rule out the possibility that differences in serum creatinine levels by Latino subgroup could reflect the impact of geographic or environmental factors not measured in the present analysis.

## CONCLUSION

The present study demonstrates striking differences in serum creatinine levels among Latinos of different national origin in HHANES, with Cuban Americans having higher creatinine levels than either Puerto Ricans or Mexican Americans. These differences persisted after adjustment for many known predictors of chronic kidney disease. Our findings draw attention to the potential pitfalls of grouping Latinos of different national origins together in epidemiologic studies of kidney disease. They also underline the need for future studies comparing the incidence of ESRD and studies of measured renal function among Latino subgroups that could help to determine whether there is a need for subgroup-specific GFR prediction equations.

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